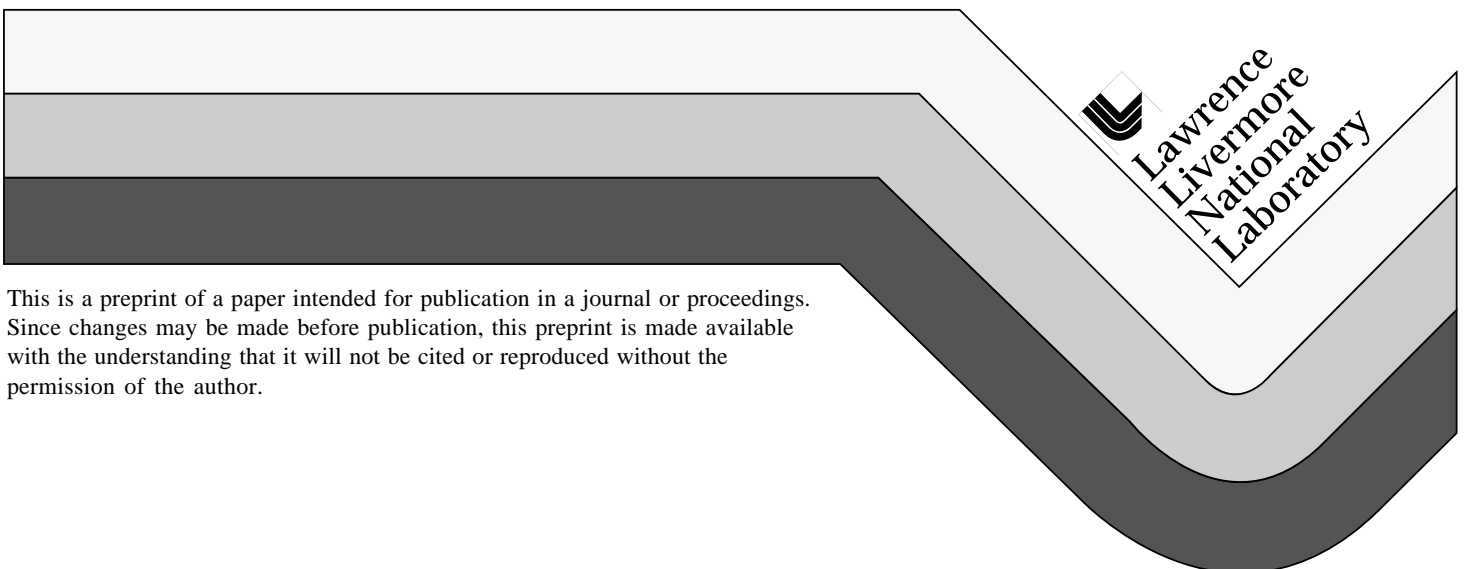


Engineering and Information Technology: Using Imaging to Reengineer Business

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Abstract

Image processing can be a great asset to business process reengineering. This paper examines image processing's impact on workflow and attempts to list the questions that should be addressed before imaging technology is introduced.

Introduction

The term "imaging processing" actually refers to two different types of imaging technology. The oldest and most predominant uses an analog photographic process to create microfiche under computer control. This is the most economical form of computer image processing. However, it has its drawbacks. Processing micrographics is slow, inflexible, different, difficult to integrate into a conventional engineering information/information technology (EI/IT) and data processing system, and ecologically unsound (film processing involves the use of toxic chemicals).

The second type of imaging technology, electronic image processing, is slowly replacing micrographics in business. Electronic image processing relies on an all-digital process that scans an image into a digitized form to be stored and manipulated electronically. Electronic image processing is much more expansive than micrographics; therefore, some firms may not choose it as the only application for archiving infrequently used documents. Electronic image processing is geared more to applications requiring frequent on-line access, such as applications that process transactions or update documents (engineering drawings, standards, specifications, etc.). In these areas of use, electronic image processing provides greater flexibility, better *productivity*, and more compact storage than either micrographics or paper files.

Document Storage and Retrieval

There are three basic media for the storage of documents. They are:

- Paper.
- Microfilm.
- Electronic imaging.

Paper is the most prevalent form of document storage currently in use. It is a familiar, low-cost method. However, use of a paper system has several significant drawbacks. Paper documents are costly to maintain, slow to retrieve, occupy considerable storage space, and must be manually filed. Access to each document is limited to one person at a time, and information security is extremely difficult to maintain.

Microfilm is the least expensive method of storing information in an imaging form. Documents can be retrieved much faster than retrieving paper, but not as rapidly as when using an electronic document imaging system.

The following are several *advantages* to document storage using micrographics. They are:

- Microfilm requires significantly less storage space than paper documents.
- Documents can be quickly retrieved using a computer-assisted retrieval system.
- Microfilmed documents are legal documents. Once filmed, the image cannot be changed or altered.
- Microfilm is a good method of storage if users need to archive document that will be accessed after long periods.
- Once a document has been filmed, it cannot be lost or misfiled, except when damage occurs to the database or retrieval system's record storage file.
- Copies of the films can be stored offsite for backup purposes.

There are, however, also several *disadvantages* to using micrographics:

- If an automated retrieval system is used, documents must be coded before being filmed, and each document's location on the film must be recorded for later retrieval.
- A document can only be viewed by one user at a time; if simultaneous access is required by more than one user, the document must be copied to paper.
- Searches for specific information contained within a group of documents are slow and labor intensive because each document must be reviewed and information compiled manually.
- Delays can occur between the time the document is filmed and when it is available for access, owing to the time needed to process the film.
- Access to microfilmed documents is normally limited to various locations within the organization.

Electronic imaging is the newest method of document storage. It provides the fastest access to stored documents, but the technology can be expensive. Currently, the advantages of electronic imaging mentioned below outweigh the disadvantages mentioned above. The advantages of electronic imaging include:

- Provides for the efficient handling of large volumes of documents in limited physical space.
- Allows multiple users to concurrently access the same document from different locations.
- Eliminates the possibility of misfiled documents.
- Allows integration of document data with various data applications.
- Provides control over how documents flow through the organization.
- Provides better control over who has access to each document; the system maintains an audit of which users access a document or file and when they access it.

- Provides access to information contained within a document via a database retrieval system that enables scanning information stored in the document file.
- Allows consolidation of redundant document files into one location.
- Allows notes associated with documents within the file to be attached to the original document for later reference.
- Allows offsite storage of backup copies of document files for disaster-recovery purposes.
- Provides database management techniques that keep related documents linked.
- Provides easier routing of documents within the organization.
- Provides better service to the customer through faster access to information.

Image processing does have a few disadvantages, however, including the high initial cost of equipment and software. Also, workflow may have to be modified significantly to make the system work efficiently.

Uses of Imaging Technology

Imaging technology offers businesses many opportunities to lower their costs for storage and access to information, to have faster access to information, and to reduce storage requirements. Some of the areas that can benefit from the application of imaging technology include:

- High-transaction-volume applications, including all types of engineering drawings, inspection documents, as-built facilities drawings, standards, specifications, work tickets, and orders.
- High clerical labor areas, such as claims, data entry, customer service, purchasing, accounting, and engineering.
- Transactions involving high paper volumes, including accounts receivable adjustments, custom manufacturing, shipping claims, and job costing.
- Slow service areas, such as accounts, shipping claims, customer service, remote locations, billing, and job costing.
- Low-quality performance areas, such as customer credits and returns, rework jobs, canceled orders, quotes versus orders, and pending case file.
- Outside relationships, including customers, vendors, and strategic integration with customers and vendors.
- Engineering information/information technology requests from users, including automation requests that involve paper integration with existing data or computer-aided design applications.⁽¹⁾

Effect of Imaging on the Organization

One of the most important strategic uses for information technology is redesign to improve the organization's internal processes. However, EI/IT managers must first evaluate how changes will reflect the workplace environment.

Simulation Tools

Simulation tools provide a way to model businesses and communicate complex real-world environments through simulation of the processes. Through the use of imaging technology, managers are able to use simulation tools and real-time operating information to see the impact of process redesign.

Accessing Multimedia Online

Imaging also has an integrating effect on an organization's existing information technology. In the past, an organization's information was accessed online through a terminal or personal computer. However, it could only be accessed if it had been entered into the system through data entry or if it had been generated by a computer system. Now, information and materials from much different, noncomputing sources can be scanned, faxed, stored, retrieved, transmitted, modified, and printed. As a result, a far greater percentage of information important to an enterprise can be found online and used to reengineer or redesign operations.

Business Reengineering and Imaging Technology

Until recently, the primary focus of data management was the care and feeding of corporate databases. Organizations used imaging primarily as a tactical tool to reduce costs associated with the amount of floor space required for document storage and copying costs. They also used imaging as a simple method of accessing and archiving documents. This focus is now changing to looking at the flows of work and data throughout the organization and reassessing how the organization actually functions. Imaging technology has a growing set of capabilities that, when used with an effective workflow management plan, offers enterprise-wide strategic opportunities.

The use of imaging in today's business is more strategic. Today's businesses use imaging technology to redesign their business processes in order to provide new and better services and products. The true value of imaging lies in reengineering organization structures and business processes.

Reengineering Organizational Structures

Business reengineering caused by imaging technology changes the structure of the organization itself. Imaging technology and aggregated data give operational employees the additional information they need to make decisions. This shift in power is caused by increased, enterprise-wide access to information in electronic form.

The migration of power and responsibility also causes a change in the way managers manage. In addition to increased access to information by employees, information

stored using imaging technology is now available to managers in a more real-time mode. This increase in information gives the manager more accurate and up-to-date information to use in strategic planning.

Image Processing and Process Reengineering

The project life cycle for reengineering workflow processes follows many of the same steps used in a systems development life cycle:

- In the analysis phase, the current information system is examined, and users are interviewed to determine the shortcomings of the system.
- In the design phase, various strategies for developing a new system are explored.
- In the implementation stage, the new system is installed and debugged, and users are trained on it.

The main difference between work process reengineering and traditional reengineering is its focus. Work process reengineering focuses on how personnel work together to accomplish the organization's strategic goals and how well those goals are aligned with the needs of customers. Traditional reengineering efforts focus on the information requirements of the organization: how and where the data are stored, who has access to the data, and how the data will be presented to the user. *This is where the issue of imaging and process reengineering come together.*

The feasibility of implementing systems to improve workflow processes depends on the availability of technology and on an organization's openness to change. Organizational changes have a greater impact on the success of the reengineering effort than any other part of the process.

Imaging and Workflow Management

The advanced records management systems that are now available are image-capable workflow management systems. In addition to scanning and storing information, these systems also control the movement of documents and images through the organization by using a set of pre-established routing rules.

Routing rules are control parameters established by programmers, users, divisions, and departments who use the system. These parameters dictate what needs to be done to an image file and where to perform that task. For example, a parameter could specify that an image document be held until other related documents enter the system (e.g., architecture/engineering project files and data), or it could specify that any document representing a certain dollar amount (e.g., firm bids for architectural engineering, procurement orders, etc.) be routed to a specific person for processing approval.

At their most basic level, workflow management systems provide a formal method for routing documents through the organization. Most business processes occur as a series of specific steps, and workflow processes shuttle digitized documents automatically along these set paths. However, the full power of a workflow management system can't be realized solely by running fixed routing schemes.

Effective imaging workflow systems are intelligent systems that encompass rules and variables about the work being performed and the people performing it. From an article entitled, "The First Steps to Imaging," in *Modern Office Technology*, Ted May

mentions some of the changes that may occur by redesigning workflow.⁽²⁾ Some of the effects of workflow redesign are:

- Eliminates tasks.
- Eliminates bottlenecks and delays between the steps.
- Enables work to be processed in parallel rather than serially.
- Provides simultaneous access to documents by multiple departments/people.
- Allows for quick, simple access to information.
- Eliminates rework/retyping.
- Provides broader responsibilities for workers.
- Decreases defects.

These effects of workflow redesign result in the following:

- Improves productivity.
- Reduces cycle times to complete work.
- Reduces costs.
- Improves customer service.
- Improves quality and consistency of results.
- Increased revenues (revenues are received sooner).

Resistance to changing the workflow occurs because potential users of imaging technology sometimes fail to see that there is a problem because they are either too close to the process, because their competition conducts business the same way, or because the competition does it better. Another factor is that some managers perceive access to information as power; in vain attempts to maintain the existing power structure, they may not want the information to flow to other managers and lower-level employees.

Organizations that establish a system that relies on the imaging technology have a strategic system that allows the organization (or company) to provide faster, more reliable service to customers while controlling costs and reducing staffing and document storage requirements.

Text Information Management Systems

Imaging systems, by their very nature, contain massive amounts of information. If this information could be easily queried, the organization's management could use it for management decisions and strategic planning. However, this is a limitation of most imaging systems, and it inhibits organizational personnel from issuing certain queries of the system—such as looking for all documents that contain a specific word or phrase. These types of queries could help management track trends or find specific items of information.

Currently, queries can be issued to existing imaging database management systems, but the user must know which documents pertain to the subject queried and then use the database query system with text information management systems (TIMS). Imaging and TIMS increase the productivity of the user by increasing the accuracy of storage. End users have increased access to information.

TIMS can operate as either a relational or nonrelational database management system (DBMS), but works best as an extended relational DBMS. As an extended

relational database management system (RDBMS), TIMS permits users to use relational terms such as join and project, as well as some nonprocedural query languages.

Another advantage of TIMS is the user's ability to issue proximity searches. By issuing proximity searches, users can locate documents in the system having two or more terms close to one another at either the paragraph, sentence, or word level. TIMS can also act as a thesaurus to find synonyms, so users can locate related, but not identical, terms and information.

TIMS can provide managers and employees with large amounts of information on a timely basis; however, certain problems still need to be resolved. Relational database management systems are not prepared to handle the massive management and access requirements of imaging because stored images tend to be significantly larger than traditional data records.

Another problem with TIMS is the massive amount of storage required for database tables. In some instances, the storage requirements exceed the size of the files containing the image. However, many analysts feel that this problem will soon be resolved through new storage techniques.

Implementation Issues

Most organizations have well-defined document management needs. Imaging technology should be integrated with any related electronic information already in use. However, other attributes of the organization need to be taken into consideration, such as the network architecture, industry standards, and the budget for integration.

Due to increasing networking capabilities, imaging technology can support a distributed environment. This enables each organization (e.g., directorate, programs, departments, divisions, and groups) to use imaging in different ways to meet their individual needs. Below is a list of questions that should be asked to determine if an organization can benefit from the use of imaging technology:

- How many fewer people will the organization need, and can the leftover staff handle new tasks such as the scanning and indexing of documents?
- What is the value of the space freed up by eliminating files? Do all the existing documents need to be converted immediately to images? Will imaging help meet the organization's record-retention needs?
- How critical to the organization's performance is the absolute reliability of document filing and retrieval?
- Measured over the past five years, what additional investment in more staff, space, and related equipment would be needed by the organization to maintain its existing paper-based system? How do those costs compare against the cost of installing and operating an imaging system?
- In relation to the organization's size, nature, location, and business, will an imaging system improve the organization's service and/or product position?
- Is workflow seriously impeded because it depends on serial-based paper processes, where only one person at a time can view a physical document? Would productivity substantially increase if several people could work simultaneously with the same (i.e., electronic) document?

- Will the organization's imaging applications deliver a large return in relation to the amount spent? Is rapid processing of documents vital? Does the process involve high-volume, high-value transactions? Is the process repetitive?
- What challenges will be faced by integrating an imaging system into the organization's existing hardware/software?

Assuming that the answers to the previous eight questions are heavily on the plus side, before the organization makes the final decision, it needs to calculate the break-even point and return on investment expected from this technology. This projection is usually done for a five-year period, with break-even factored by many variables. Users of imaging technology generally agree that a break-even point should be somewhere between the second and third year.

Conclusion

In a competitive business environment, the ability to quickly transfer information may be the difference between success or failure for an organization. Being able to quickly access information allows businesses to provide better services and products to their customers.

Imaging systems offer organizations an opportunity and means to do work in ways not possible before. The idea of having pictures and usable data available on a computer terminal at the same time encourages the discovery of many new users for this technology.

One of imaging's greatest strengths comes from the change it brings to the basic workflow process, where it causes the rules of business success to be redefined. Workflow management systems used in conjunction with imaging systems pose a challenge as well as new opportunities to a business. From a strategic point of view, the benefit of imaging is the ability to manage and control new business processes better.

The number of potential imaging applications is increasing as more organizations install imaging systems and those who already have them move imaging applications into new areas of operations. New ways are being discovered to collect and analyze information through imaging technology, which enables businesses to become more competitive. Each organization should assess the appropriateness of different imaging methods in order to gain the maximum benefit from imaging technology offers.

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